Self-cleaning multi-functional coatings with good robustness, high transmittance and superamphiphobicity

Junhui He and Zhi Geng

Functional Nanomaterials Laboratory, Center for Micro/Nanomaterials and Technology, Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, Zhongguancundonglu 29, Haidianqu, Beijing 100190, China.

Corresponding author: jhhe@mail.ipc.ac.cn

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Self-cleaning multi-functional coatings with good robustness, high transmittance and superamphiphobicity are attracting much attention because of their wide potential applications. In the current work, three different nanostructures were assembled sequentially to build highly antireflective superamphiphobic coatings. A typical coating consisted of 5 layers of 20 nm silica nanoparticles, 2 layers of 80 nm hollow silica nanospheres and 3 layers of mesoporous silica nanosheets deposited on glass substrate. For this particular coating, the contact angle was 171^o for water, 157^o for diiodomethane and 156^o for ethylene glycol, respectively. The maximum light transmittance obtained was as high as 96.1% at 530 nm, while only 91% was transmitted through blank glass substrate. Simple chemical vapour deposition (CVD) of tetraethyl orthosilicate was then applied to improve the robustness and adhesion-to-substrate of the coating. The contact angle of coating reached 171^o for water and 152^o for ethylene glycol, respectively. The maximum transmittance measured using an integrating-sphere photometer was 98.7% at 1580 nm. The coatings withstood the 4H pencil scratching test, tape peeling test, sand abrasion test and water-drop impact test. The effects of CVD conditions on the robustness and adhesion-to-substrate of the coatings were also investigated. The multi-functional coatings could overcome the large barriers commonly encountered in practical applications due to their good robustness, high transmittance and superior superamphiphobicity.

Fig. 1 Digital image of the S5S'2S''3 coating with water (A), ethylene glycol (B), diiodomethane (C) and hexadecane (D) droplets on its surface.

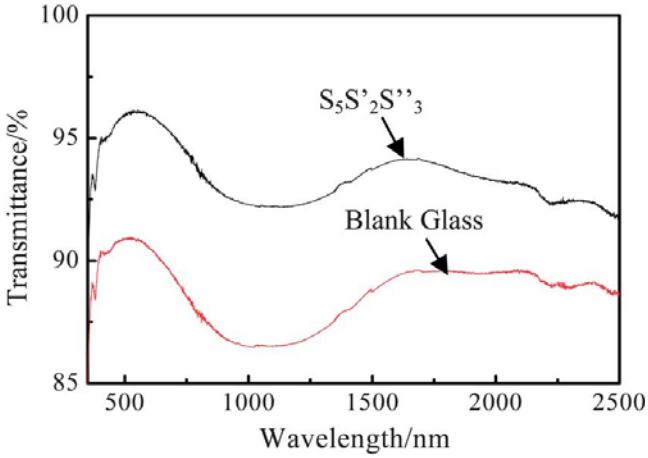

Fig. 2 Transmission spectra of blank glass substrate and the $S_5S'_2S''_3$ coated glass substrate recorded by an integrating-sphere receiver.

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